USING GAME MECHANICS IN DESIGN THINKING METHODOLOGY

A THESIS

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Introduction

On July 1, 2018, historic legislation was passed by the Indiana House of Representatives to formally commission Ball State University (BSU), located in Muncie, Indiana, to manage a distressed school district, Muncie Community Schools (MCS). This brought reactions ranging from excitement and hope to anxiety and skepticism among MCS teachers and community members, and many community members have stepped up to volunteer and support this partnership during a challenging time for the school district. A graduate research team from the Center for Emerging Media Design and Development (EMDD) responded to the challenge by developing a design thinking game to elicit crucial feedback from MCS teachers for BSU's newly appointed leadership team. This case study chronicles the development of *Aha! The Game* and explores how combining game mechanics with a design thinking framework affects participants' engagement and satisfaction with brainstorming intended for use in an educational environment, specifically in a low-performing school.

The game's purpose was to generate input from the teachers in a short period of time for the *Academic Innovation and Financial Viability Plan* to be presented to the Indiana legislature in June 2020. The goal of the game experience was to provide teachers a voice to express what is happening in their classrooms and to bridge the communication gap between teachers and administration to bring positive solutions to these real challenges. The following research questions are addressed:

RQ #1: To what extent does introducing game mechanics into a design thinking exercise increase the motivational tactics used to engage participants?

- RQ #2: To what extent does combining design thinking with game mechanics generate more nuanced ideas from participants?

Aha! The Game was specifically developed for the MCS district, located in Central Indiana. MCS is one of seven school districts in Delaware County, which has a population of 114,772 (U.S. Census Bureau , 2018). MCS is ranked the worst school in Delaware County (Niche, 2019), and all schools within the district fall below the state average in academic testing (IDOE, 2019). The school district's enrollment peaked at 19,104 students in 1970 but has declined to only 5,264 students in the 2018-19 school year (IDOE, 2019). With this declining enrollment, the school district has accumulated $12 million dollars of debt, and it is estimated the district loses $7,000 each time a child leaves the school system.

The dire financial situation in MCS, as well as the low academic performance, prompted unprecedented legislative action to transition the management of the school system to BSU. Indiana House Bill 1315 was initiated as a financial management plan for distressed school corporations and allows a distressed unity appeal board (DUAB) to delegate board authority and duties. The bill included Gary Community Schools and MCS and converted Gary's governing board to an advisory board. The board was required to "consult with the mayor, the fiscal management board, and the governing body when developing the school corporation's annual budget and developing a financial plan" (Indiana General Assembly, 2017).

On January 1, 2017, DUAB assumed full control of MCS; and after review of the MCS documentation, it was determined that MCS did not make enough financial progress to regain control of the school system (Sollars, 2018). In December 2017, the DUAB approached BSU to play a leadership role in MCS's future. In February 2018, the bill was amended for BSU to

assume management of MCS in July 2018. During this management period, BSU's goal is to create a long-term plan for MCS that will result in a superior education for students. The focus of the first year is gathering input from the community about the future of MCS.

On July 1, 2018, a newly formed partnership between BSU and MCS officially began. After the partnership formed, one of the first actions was to appoint a new school board. This was an unusual arrangement and was criticized by some in the community since board members were not elected by voters, as is normally the procedure. As the first year of the partnership concludes, the community remains hopeful that Ball State's involvement will bring innovation and resources to improve the academic performance. Others, however, are less optimistic and are concerned that action is not being taken quickly enough to remedy the situation.

One significant accomplishment during the first year was the formation of the Joint Academic Innovation Council "to create innovative programs and strategies that improve the academic performance of MCS students" (Ball State University, 2018). The council will be presenting a long-term *Academic Innovation and Financial Viability Plan* to the Indiana legislature in June 2020. The MCS/BSU partnership has been widely discussed in the community, as well as among the BSU student body. Ball State's President Geoffrey Mearns says that although there are admittedly challenges to overcome in MCS, the joint partnership inherits a "positive legacy of innovation and success for our students" (Rao, 2019).

The community, as well as the BSU student body, has responded to the recent changes in MCS with increased volunteer involvement. A graduate team from the Center for Emerging Media Design and Development (EMDD) at BSU developed a creative project to support the MCS/BSU partnership. The EMDD program focuses on three disciplines: design thinking,

human-computer interaction, and cross-platform storytelling. Students are prepared to manage interdisciplinary teams that use advanced storytelling techniques to advance an organization.

In August 2018, the EMDD team met with the MCS/BSU liaison to discuss the team's proposal to use design thinking to facilitate a new and exciting direction for MCS by inspiring creativity from already dedicated educators that share a desire to strengthen MCS. BSU's goal for the first year of the partnership was to gather input from the community to inform the direction of the *Academic Innovation and Financial Viability Plan*. Many efforts had already been made by BSU and MCS leadership with public forums and a family information night. The EMDD team suggested that they could help BSU turns its attention to gathering input from MCS educators by using design thinking, "a methodology for creative problem solving" (Raz, 2017). BSU's leadership gave full permission for the team to move forward with the project with the requirement of using a brainstorming tool known as a Strengths, Weaknesses, Opportunities, Threats, and Aspirations (SWOT-A). The team returned to the EMDD lab to consider how they might create an experience for teachers that is perhaps more engaging than a conventional SWOT-A and provide valuable input for the *Academic Innovation and Financial Viability Plan*. The graduate students used design thinking to create an innovative solution for data gathering from MCS educators using a six-step process: 1) frame a question to define the problem space; 2) gather inspiration by empathizing with the human needs; 3) generate ideas to stretch the boundaries of obvious solutions; 4) make the ideas tangible by creating a prototype; 5) test to learn and advance the solution's progress with iterative design; and 6) craft a human story to share (IDEO U, 2018).

The team's empathy research revealed that teachers were experiencing low morale and high anxiety about the future. Teachers even outside of MCS felt underpaid and overworked. When asked what would motivate him to stay for an after-school session, one teacher responded, "Food and fun!" The team began the idea generation process and landed on the idea of using gamification within the design thinking framework to introduce fun. The purposeful play through a game experience would facilitate creative idea generation from teachers. Since multiplayer games always begin with a cooperative agreement, it establishes common ground among the players (McGonigal, 2011). Collective commitment could be especially important to establish an environment where participants are potentially distracted by apprehension about current challenges or a bleak future. The research team created and tested several low-fidelity game prototypes to facilitate successful idea generation before reaching the final version, *Aha! The Game*. The game was played by 98 teachers at 10 MCS locations and resulted in the collection of 2,547 data points. A game experience survey was also completed by 81 of the 98 participants to measure the quality of the experience.

This case study contributes to the design thinking field by exploring a new method of using game mechanics combined with the design thinking to increase motivation of participant engagement and create an opportunity for crucial feedback and quality idea generation. Additionally, this research introduces an effective tool for teachers to provide critical feedback to their administration in an unthreatening way. In the case of *Aha! The Game,* teachers were inspired to provide feedback and empowered to dream about possible solutions to the challenges facing MCS. This design thinking exercise could be especially useful in a school system in crisis

where educators are experiencing low morale and need a tool to elevate their thinking and inspire creativity.

Literature Review

This thesis draws from research and practice in the fields of design thinking and gamification as a means for creating the right environment for design thinking participants to create meaningful solutions to sometimes complex problems. A definition for design thinking is examined, strengths and weaknesses for the discipline are identified, and environments where design thinking methodology has succeeded are reviewed. Gamification is defined, and the idea of combining gamification with a design thinking framework is explored. Finally, using design thinking to solve complex social or "wicked" problems (Rittel & Webber, 1973; Buchanan, 1992), like a distressed school district, is discussed.

Design Thinking Defined

Design often focuses on the aesthetics or function of a product. With aesthetic design, engineers might develop the product and hand it to designers to make it more attractive. This design approach represents a limited view of design's application and its potential to affect change. In a TED talk, *Designers--think big!,* Tim Brown, the CEO of IDEO for nearly two decades, says, "…this small view of design is a relatively recent phenomenon, and in fact really emerged in the latter half of the 20th century as design became a tool of consumerism" (Brown, 2009). A large view of design, known as design thinking, elevates the role of designers and brings them into the development process earlier. It could expand beyond a tangible product and apply design principles to a system or a process. Although design thinking has been around for a while in science and some engineering fields, the term was first coined for use in business by David Kelley, a Stanford professor. Kelley founded David Kelley Design (DKD) in 1978 and

went on to merge his company with Bill Moggridge and Mike Nuttall to form IDEO, a global design company. Since 1991, IDEO has been a forerunner for using design thinking in business and asserts that design thinking could solve global-sized problems. The outcome of design thinking may still be an aesthetically beautiful product, but the process to formulate the solution is inspired by human needs.

Brown summarizes the scope of design thinking as "a set of principles that can be applied by diverse people to a wide range of problems" (Brown, 2011, p. 6). It is a non-linear, iterative design process that applies conventional design principles in a new way using an interdisciplinary, collaborative approach to create an innovative solution. Design thinking is at the heart of 21st century learning that is now being implemented in schools. It is becoming a common way of approaching problem-solving in not just the design industry but also in health care, service industries, and technology. Collaboration or collective intelligence is key to design thinking involving a diverse representation of specializations and expertise. Human interaction and usability are other key elements that continue to influence the field of design.

Design thinking expands a designer's role by involving them in creative problem solving, developing systems, and human interaction experiences. It encourages professionals from disciplines other than design to think like a designer to transform the way products, services, processes, and even strategies are developed (Brown, 2008). Design projects pass through three spaces: inspiration, ideation, and implementation. Inspiration is a problem or opportunity, ideation works toward a solution, and implementation is putting that developed solution on the market. Design projects will cycle back through these stages as the project moves forward.The design thinking process as defined by IDEO has six steps: 1) frame a question to define the

problem space; 2) gather inspiration by empathizing with the human needs; 3) generate ideas to stretch the boundaries of obvious solutions; 4) make the ideas tangible by creating a prototype; 5) test to learn and advance the solution's progress with iterative design; and 6) craft a human story to share (IDEO U, 2018).

Design thinking allows non-designers access to personalize a designer's process in many different contexts. Education, for example, is exploring how design thinking could be used to give students access to designing curricula (Fass, Chui, & Rutgers, 2018). Design thinking is being introduced into a cross-disciplinary, integrated educational model at Stanford University's d-School. It is a new teaching model that addresses changes in the design environment and has been found to improve teaching and student participation (Tu, Liu & Wu, 2018). At Stanford University's d.school, a design thinking framework is used to empower every person to apply design principles to their discipline (Plattner, 2010).

Strengths and Weaknesses of Design Thinking Identified

Design thinking, a codified, six-step process, has been criticized for being too formulaic and rigid to create true innovation (Iskander, 2018; Jen, 2018; Nussbaum, 2018; Walters, 2011). Natasha Jen, a vocal critic of design thinking, studied graphic design at the School of Visual Arts in New York City and received her Bachelors of Fine Arts. Jen is a partner at Pentagram, a design firm. Jen suggests that design thinking is too structured to result in true innovation and has shifted the creative process from exploration to prescription. Jen's biggest concern is that the yearning for formulas has caused designers to abandon skepticism about design thinking.

Design experts have touted the cross-disciplinary nature of design thinking as beneficial to creating innovative solutions (Brown, 2009; Buchanan, 1992; Norman, 2019). They claim that

more innovative ideas will be generated from a diverse, cross-disciplinary team rather than a homogeneous design team. Critics like Jen, however, claim design thinking is the democratization of design, and the counter response to design thinking is cross-pollination between disciplines. Brown and Kelley, who are credited with popularizing design thinking in business, believe cross-pollination between disciplines is already a foundational principle for design thinking.

Others claim that design thinking excludes the viewpoint of everyone but the powerful or those who consider themselves experts (Iskander, 2018; Norman, 2019). Natasha Iskander, Associate Professor of Urban Planning and Public Service, conducts research on the relationship between migration and economic development. Iskander claims design thinking is an old method labeled as something new. Iskander criticizes design thinking for favoring the powerful and preserving the status quo. Her biggest reservation was the method in which the winner was chosen from *Rebuild by Design*, a design competition to collaborate and create solutions in response to Hurricane Sandy's devastation. Iskander claims that the process to reach this solution was exclusive and favored the designers in the *Rebuild by Design* competition; however, she then praised another solution entered in the same competition that used the same process as acceptably inclusive. Since then, *Rebuild by Design* has become a groundbreaking organization that has served as a model across the world based on collaboration to enable communities to grow stronger and become better prepared to stand up to whatever challenges tomorrow brings (About Rebuild, 2019). An opposite to Iskander's perspective of design thinking being exclusive is that inclusion will involve average people, and they will not necessarily give the most valuable

feedback about designing a solution (Jen, 2018). This viewpoint believes that expert designers have superior skills over the average person, and this will result in a more innovative solution.

A third perspective is that having a top-down or expert knowledge and a bottom-up or community knowledge approach to the design process will yield the best results (Norman, 2019). Don Norman, a designer known for advocating human-centered design, recently expressed concern that empathy research could be an impossible task (2019). This could be especially true of global problems where experts do not understand the local culture. Although Norman believes empathy research is still an appropriate part of the design process, he states "experts coming in and telling people what to do is also really paternalistic and doesn't work" (2019). Norman suggests involving design experts is important but so is involving creative people within the local community to provide local knowledge.

Peter Merholz, a leading experience designer, suggests that design thinking won't save you but innovating like a kindergartener could (2014). Merholz says, " … we should get off our high horses and stop referring to these innovation practices as 'design thinking,' but instead 'kindergarten doing.' " In kindergarten, everyone draws and creates regardless of their ability. In this safe classroom environment, children are encouraged to take turns, and everyone is on equal footing. This actually describes a solid foundation for collaborative and creative teamwork that could work with adults in any environment. In many first grade classrooms, however, the environment becomes more structured with individual desks in neat rows with less group interaction. This highly regimented educational environment, which continues in many schools through graduation, was thought to prepare students for the industrialized world. In fact, school bells signaling the beginning and end of a class period was inspired by the factory's shift bells

(Watters, 2015). This regimented culture has also impacted the corporate culture (Schuneman, 2018). According to IDEO's Michael Hendrix, a more regimented culture could contribute to the potential failure of designing thinking (Schwab, 2018). Hendrix says, "Playfulness and joy don't need a reason other than that they create the conditions . . . to allow people to be more creative" (Schwab, 2018). Hendrix attests that cultures highly optimized to promote efficiency tend to push playfulness aside. If the right condition for play is not created, the success of design thinking will be limited.

Although there has been much debate for the past decade about the efficacy of design thinking or whether design thinking is just a passing trend, it is worth considering that the principles behind design thinking have been around much before it was popularized in the 1990s. Inventor Thomas Edison could be considered a prolific design thinker. Although we often remember Edison for his invention of the light bulb, he also designed the system of electricity to power the lightbulb (Brown, 2008). He envisioned how people using the lightbulb would revolutionize their lives, and this is what he focused his invention efforts toward. Edison was a system thinker who was reinventing the world. More recently, however, design moved away from system thinkers to "a priesthood of folks in black turtlenecks and designer glasses working on small things" (Brown, 2009, 4:26). Design thinking is shifting back toward making design big.

Environments Where Design Thinking Succeeds

In 1980, Steve Jobs approached IDEO to design an innovative solution to replace the costly mechanism in the first mouse (IDEO, n.d.). IDEO landed on a solution that was less expensive, easily manufacturable, and pleasurable to use. This design is still in fact used in most

mechanical mice being manufactured today. Design thinking can be used to tackle problems as small as a computer mouse or as massive as world problems like the global water crisis, food insecurity, and lack of education. A design thinker uses empathy, integrative thinking, optimism, experimentalism, and collaboration to craft a solution outside the bounds of typical (Brown, 2008). The design work is done carefully within the constraints of the project, which is best defined as what is feasible, viable, and desirable. By balancing desirability with feasibility and viability, innovation can be achieved (IDEO U, n.d.).

UberEATS has combined the technology of the smartphone, which has been around for just over a decade, with a very old and fundamental practice of preparing and selling food (Smith, 2017). They have used a very similar process to design thinking to create this innovative solution. The designers at UberEATS immerse deeply with their consumer and their locales. The Walkabout Program sends designers to more than 80 cities where UberEATS exists to experience the city's food culture. Order shadowing allows them to observe their designs in use in real time by following their delivery partners and sitting in people's homes while they order dinner. Designers respond to the knowledge they gain with immersion by iterating designs quickly. The developers of this relatively new app are committed to continuing to innovate quickly.

Design thinking has even seen success in global health care. India's Aravind Eye Care System is a large provider of eye care that has used principles of design thinking. (Brown, 2008) The founder of Aravind, Dr. G. Venkataswamy, asked the question: How might needless blindness be eradicated among India's population, including the rural poor, through the effective delivery of superior ophthalmic care? The solution was to create an eye care system that included

mobile clinics to serve the population in the countryside and to open a manufacturing facility for ophthalmic products in the basement of the hospital to reduce costs. This has allowed Aravind to provide a solution to a complex social and medical problem.

Gamification Defined

The use and popularity of gamification has exploded in recent years. One catalyst for the growth of gamification has been emerging technology. This has provided more information and tools for individuals to act independently from the institution. For example, a patient can research his or her symptoms prior to a visit with the doctor to enable having an informed conversation with the doctor. Patients have become a partner in their health care. Since individuals have become less centered around institutions, they are less responsive to top-down mandates and are more accustomed to possessing some decision-making power (Rigby, 2014). Scott Rigby, a gaming psychology expert, states, "... the motivation to find ways to understand what deeply motivates individuals in order to keep them engaged has never been stronger …" (Rigby, 2014, p. 114). Gamification has been a welcomed resource in this recent change of mindset.

An obvious explanation for why gamification is effective in motivating individuals is that it is fun, and people become more engaged in fun activities. The psychology of fun is, however, a topic with limited empirically validated research. A theory of intrinsic motivation defines fun as a positive emotional state with a playful enjoyment where there is intrinsic engagement during the activity (Deci & Ryan, 2000). A playful experience like a game is the stimuli, but the intrinsic engagement is the actual source of value in the individual's experience. Patrick Jordan uses a four-pleasures model first espoused by Lionel Tigers, an anthropologist, in 1992, as

inspiration for three quantitative dimensions: positivity, activation, and dominance (Jordan, n.d.). These dimensions are defined as follows:

- Positivity — emotion makes the person feel good or bad.
- Activation — amount of energy and stimulation in emotion causes.
- Dominance — the extent to which the person experiencing the emotion perceives that they have power in the situation.

This is combined with a fourth dimension that is qualitative:

- Feeling — description of what it is like to experience a particular emotion.

A positive game experience has the potential to create a positive emotion, to activate energy and stimulation in the participant, and to provide dominance with gameplay control. According to Jane McGonigal, an American game designer, gameplay provides "an optimistic sense of our own capabilities and an invigorating rush of activity" (McGonigal, 2011, p. 28). McGonigal also suggests that play is actually disguised work that individuals voluntarily choose to do, which provides a sense of accomplishment and satisfaction. An emotional benefit to "hard fun" (2011, p. 28) is fiero, which is the Italian word for pride. This is believed to be a primal emotion, which may have been one of the primary emotions present to motivate taking risks and exploring by early humans. Gameplay specifically has been found to enhance problem solving skills (Cooper, 2014). Gameplay creates a fun environment that could possibly motivate individuals to take more risks to solve a problem.

Gamification Mechanics and Design Thinking Framework Combined

Samantha Julka, a design thinker and founder of Doris Research Labs, runs a design firm that focuses on facilitating the design thinking process of designing work spaces (S. Julka,

personal communication, May 21, 2019). Julka occasionally is asked to aid an organization in design thinking for other solutions beyond facility space design. In once such case, she was invited into a corporation within the science industry. Her first design thinking session with highly capable engineers and scientists resulted in 25 ideas and her second session in 60 ideas. Although this exceeded the expectations of Julka's client, she knew these results were far under the normal results from design thinking. Julka's team began considering a solution to create a more engaging, productive experience for these professionals. Informal observational research yielded the answer. During session breaks, the engineers and scientists were seen playing Pokémon GO with light-hearted bantering among the group. This inspired the team to ask: How might we create a playful experience to facilitate design thinking and increase creative output? The answer was an idea generating card game, *Pick-A-Prompt*. The game yielded an astonishing 400-500 ideas, which later resulted in the organization implementing a multi-million dollar idea.

Design Thinking and "Wicked" Problems Examined

There is tension between the scientist's and designer's way of approaching a problem in the design thinking process. This dynamic is described as a "wicked problem" in design thinking, a term coined by design theorists, Horst Rittel and Melvin Webber (1973). Rittel and Webber suggest that using a scientific base to solve a complex social problem is not likely to succeed because science solves "tame problems" that are more easily defined. Richard Buchanan (1992), a design thinking scholar, looks for scientific features of design to connect arts and science to real-world problems. One source of "wicked problems" where design thinking could be especially beneficial are complex systems or environments for living, working, playing, and learning. A specific example in this category of "wicked problems" are distressed school

systems. School systems in dire situation will certainly need educational and financial experts to guide their recovery. By introducing the cross-disciplinary nature of design thinking to this "wicked problem," the best solution can be reached.

The EMDD team who proposed facilitating design thinking with MCS teachers are not educators; however, they bring the expertise of design thinking to the educational setting. The educational experts are the teachers. Both the design thinking expertise and the educational expertise were critical to the success of the design thinking sessions.

Methodology

This case study chronicles the development of *Aha! The Game* using a design thinking methodology. The process began with empathy research with key stakeholders, followed by idea generation by the team to create a solution that is centered on the stakeholders' needs. This chapter provides a review of the iterative design of the game and the progression of the game prototypes. The methods for facilitating the design thinking session are outlined, as is the method for evaluating the participants' experiences during gameplay.

Empathy Research

To understand the stakeholders' needs, the EMDD team began with empathy research. The team conducted stakeholder interviews, attended public forums, and engaged in informal conversations with educators, families, and Muncie community members.

Stakeholder interviews

Interviews were conducted with eight individuals, including Muncie community members, BSU professors, MCS parents, BSU employees, a principal, BSU and MCS graduates, retired teachers, and a school psychologist. Questions were designed to elicit their involvement with MCS, their thoughts on the future of the school district, the personal effect of MCS' struggles, and their perspective on the MCS/BSU partnership (see Appendix A for a complete list of interview questions).

Observational research

The EMDD team also attended the Ball State University public forum on June 12, 2018, at Muncie Central H.S., where 20 MCS/BSU board candidates were presented to an audience of

200 community members. Each candidate provided one idea that he or she believed would transform the Muncie community and outlined how to encourage families to return to MCS. BSU president Geoff Mearns provided information about the board appointment process and announced that MCS employees would remain employed with no compensation reduction.

Additionally, the EMDD team attended a second Ball State University "Even Better Together" public forum on June 18, 2018, at Horizon Convention Center and participated in design thinking activities designed to develop big ideas from the community about how to improve the Muncie community. Participants were asked to write one big idea and the next step required to implement the idea on a card. Next, they were instructed to trade cards with another participant to discuss and rate each idea on a scale from 1 (weakest) to 5 (strongest). The process was repeated five times, and each card received five scores. The participants were then instructed to add the scores on the card for a total score. The top 15 ideas were identified and read to the entire assembly. These ideas were then placed on easel charts throughout the room. Small groups were instructed to gather around each of the 15 easels to discuss the next steps and obstacles for an idea to be implemented. Each idea or obstacle was written on a Post-It note and placed on the easel with the big idea. Each group then appointed a spokesperson to report on the small-group discussion.

Finally, the EMDD team attended the Family Information night at MCS on June 28, 2018. Approximately 200 people were in attendance, and the group was mostly comprised of teachers. During the assembly, the role of the MCS/BSU liaison was explained, and BSU's task of managing the school system was reviewed. After the presentation, the floor was opened to a question-and-answer session.

Iterative Game Design

After the EMDD team had completed the research process, the feedback gained suggested that a design thinking game could be an effective tool for facilitating the design thinking sessions with teachers. The game was created using a rapid, iterative design process that was nimble enough to quickly create an effective design thinking game. Each prototype was designed and tested with users on a low-fidelity model specifically focused on improving and further developing the game concept. The last prototype was the final version and was the only prototype used in 10 design thinking sessions with 98 MCS teachers. These 10 sessions generated 2,547 data points from *Aha! The Game*

Round One: Game Prototype One – Trivial Pursuit Format

The first design thinking game was developed using a pie-shaped pawn and a game board similar to Hasbro's *Trivial Pursuit* (see Figure 1). The object of this iteration of the game was to get the best answers in the least amount of time. The players were instructed to move around the board and answer design thinking prompts in each color category. Each answer earned the player a piece of pie with the specific color for the category. As players answered prompts, they recorded their answers on a game sheet. The first player to fill the pie pawn with each color was declared the winner. All players continued to play until their pie pawns were filled.

A low-fidelity game prototype was tested with a group of 10 usability and user experience testing participants comprised of graduate students in the EMDD program (see Figure 1). For this reason, the design thinking prompts are tailored toward the group. The questions were organized into three color categories. Orange category questions addressed: How might we create the ideal low-residency EMDD program? Purple category questions addressed: What is

one immediate change that you would make today to the low-residency EMDD program? Green category questions addressed: How might we better promote the low-residency EMDD program? Each category contained four prompts that related to the overall question and encouraged participants to generate big ideas to improve the EMDD program. The prompts started with parameters like "if there were no financial constraints, I would (insert big idea) ..." A few of the prompts asked participants to write down three quick ideas on a particular topic (see Appendix B for a complete list of game prompts). The goal is to inspire participants to quickly generate big ideas.

Figure 1. EMDD students and faculty participating in a usability test for Game Prototype One

Participants provided feedback about the gameplay experience, as well as the entertainment value and game logic. The graduate team also observed the gameplay in progress and took notes on both positive and negative reactions from the players, parts of the game that created energetic interaction among the participants, and any game logic errors. After the observations were complete, common themes were identified in the researcher's notes about the

gameplay and feedback from the participants. Based on this information, the game was redesigned, and a second prototype was developed and tested.

Round Two: Game Prototype Two– Board Game Format

The second design thinking game prototype is named *Dream Infinitely*, and the game board resembled an infinity symbol (see Figure 2). The object of the game was to create ideas, choose two of the best ideas, and anonymously submit those ideas to the other players to be scored. The player who receives the highest score for their ideas is the winner. A prototype was tested with eight new EMDD graduate students (see Appendix C for a complete gameplay script).

The game is played in four rounds. During the first round, participants were instructed to roll a die to move their game pawn to a space on the board. The players draw a card (see Figure 3) from one of three card decks that match the color of the space where their game pawn landed. Players do not take turns but rather play concurrently. The card provides a prompt, and players were instructed to record their responses on the cards (see Appendix D for a complete list of the game prompts). Gameplay for the first round continued for 20 minutes. At the completion of the first round, the regular gameplay was interrupted for a special *Bus Stop* question. The players were given one minute to answer the question on the *Bus Stop* card and record their responses. The players were then given two minutes to share their answers with the other players before resuming gameplay.

In the second round, players were asked to choose two of their best responses and rate them one (just okay) to five (outstanding). Players recorded the rating on their cards. In the third round, players were instructed to pass the two ideas that they selected to the left to be rated by

their peers. The cards were then passed around the table until every player had scored each card. In the final round, players totaled all the numbers on their cards. The player who received the highest total score on their answers was the winner.

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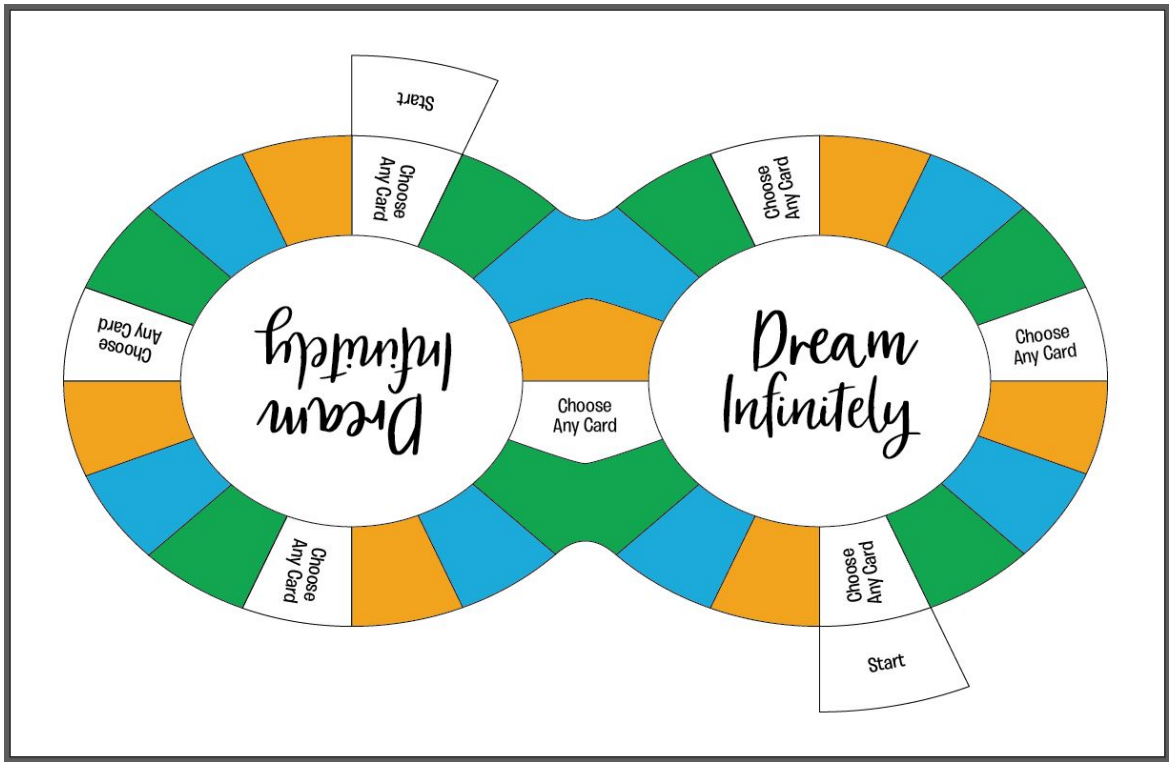

Figure 2. Game board for *Dream Infinitely* Game Prototype Two

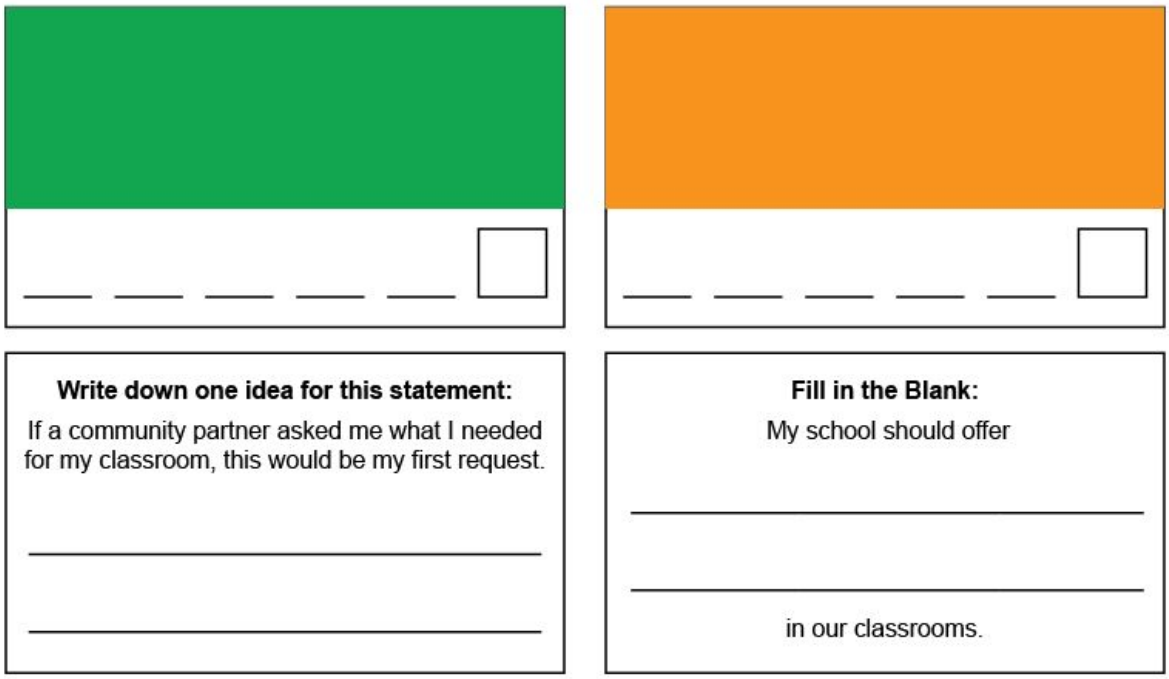

Figure 3. Game cards for *Dream Infinitely* Game Prototype Two

Round Three: Game Prototype Three – Card Game Format No. 1

The third design thinking game eliminated the game board but used the same prompt cards as Game Prototype Two. The prototype was tested with four educators and parents. Each player was given three decks of cards with prompts. The card game involved rolling a color-coded die and drawing a card from the correct deck to match the color on the die. The player then read the prompt and recorded the answer on the card drawn. Players took turns rolling the die and answering the prompts until all the cards had been drawn.

Participants provided feedback about the gameplay experience, as well as the entertainment value and game logic. The graduate team also observed the gameplay in progress and took notes on both positive and negative reactions from the players, parts of the game that created energetic interaction among the participants, and any game logic errors. After the observations were complete, common themes were identified in the researcher's notes about the

gameplay and feedback from the participants. Based on this information, the game was redesigned, and a fourth prototype was developed and tested.

Round Four: Game Prototype Four – Card Game Format No. 2

The EMDD team performed a cognitive walkthrough of the game prototype with two expert users before presenting the prototype to the MCS . The object of the game is for the players to gather as many "apples" as they can while playing the game. The person with the most apples at the end of the game wins a prize. The game includes a set of 12 cards with prompts in four color categories: 1) Yellow Theme: Inside the school (education, specials, technology, etc.); 2) Green Theme: Outside the school (community, partnerships, etc.); 3) Red Theme: Uniqueness of each school; and 4) Yellow-Orange Theme: *Bus Stop* questions (see Appendix E for a complete list of the game prompts). The game is played in 12 rounds, and in each round a new judge is appointed by rotating around the table (see Appendix F for complete instructions for gameplay). The judge shuffles the cards and reads the prompt to the group. Players answer the prompt and record their answers on the answer sheet. The players then turn in their answers to the judge who determines the best answer. The winner of the round is then awarded an apple. The judge places the answers in the correct slot on a 12-slotted holder. During gameplay, a *Bus Stop* card could be drawn. The "judge" reads the question on the *Bus Stop* card. All players write an answer to the question on their *Bus Stop* card. The players put their *Bus Stop* cards in a bucket for a prize drawing. Once all 12 prompts are answered, the game is over.

The first cognitive walkthrough of *Aha! The Game* with the EMDD team revealed no major flaws. The second cognitive walkthrough with the MCS/BSU liaison provided some additional insight into the needs of the stakeholder. The game was revised to address those

needs. The next prototype was used in the design thinking sessions with MCS teachers without further testing.

Round Five Final Game Prototype – Aha! The Game

The fifth design thinking game is a refinement to Game Prototype Four of *Aha! The Game.* This was the final high-fidelity prototype that was used to facilitate the design thinking sessions with MCS teachers (see Figure 4). The object of the game is for players to gather as many "apples" as they can while playing the game. The person with the most apples at the end of the game wins a prize.

Figure 4. Aha! The Game Final Game Prototype

The game includes a set of 12 cards in three color categories: 1) Yellow: Dream big questions; 2) Green: Processes to fulfill the big dreams; and 3) Red: Resources needed to fulfill the big dreams. The yellow category for dreaming big ideas, which establishes a foundation for

the other categories, includes the following question prompts (see Appendix G for a complete list of the game prompts):

- If I could create a dream classroom, what would it look like?
- Where would I like to see my school in five years with the help of Ball State?
- What are things I dream about for my school?
- In five years, if someone asked me about my school, I'd want them to describe it with these words.

Aha! The Game Facilitation

Aha! The Game, in addition to a SWOT brainstorming activity, was facilitated during a 90-minute session at 10 MCS school locations (see Appendix H for a complete script for the sessions). The 98 participants included elementary, middle school, and high school teachers. After a brief introduction, the SWOT activity began. Participants were given a marker and a pad of Post-It notes before being divided between four easels with different prompts for strengths, weaknesses, opportunities, and threats. The prompts were as follows:

- Strengths: In what areas does your school excel?
- Weaknesses: What are areas that your school can grow in?
- Opportunities: What are opportunities found in your school that could help you get to the next level?
- Threats: What are areas in your school that may cause your school to struggle?

Participants were given two minutes for each prompt to write responses on individual Post-It notes and place the responses on the easel pad. After two minutes, participants were given stickers to mark what they believe to be the most important answers on the board. Participants

then moved to the next prompt and repeated the process. Participants were given a break before beginning *Aha! The Game.* The following instructions were given to guide participants through the first round of the game:

- During each round, one of you will be the judge. If you have a deck cards in front of you, please raise your hand. You are the judge for the first round.
- Judges, please draw a card from the deck. Read the question to the players.
- Now, everyone grab your answer sheet. All players, including the judge, should write your answers on your answer sheet. You have two minutes to write down your answer. Be creative. The judge will rank your answers.
- Your time begins now!

After all 12 rounds were played, participants counted how many apples they earned, and a winner for each table was announced.

After the design thinking game had been facilitated at 10 MCS schools, the research team entered the data into a spreadsheet. The data were coded and grouped into similar categories. With these groupings, the team was able to identify seven key themes from the data. After the information was synthesized, the team returned to MCS and conducted a data validation survey to determine whether teachers agreed that the themes identified by the research team were valid.

Game Experience Questionnaire

A 65-question survey for the game experience was administered to 81 of the 98 participants playing *Aha! The Game* (see Appendix I for a complete questionnaire). The survey was revised from a game experience survey developed by a research group from Eindhoven University of Technology (IJsselsteijn, de Kort, & Poels, 2013). The questionnaire was given to

participants at the end of their gameplay. The instrument is designed to gage participants' gameplay in terms of tension/annoyance, negative experience, challenge, flow, positive experience, sensory/imaginative immersion, and competence. The participants answer the questions on a Likert scale between 0 and 4 (0 = not at all, 1 = slightly, 2 = moderately, 3 = fairly, 4 = extremely). In this case, challenge is referring to the level of engagement and difficulty of the game. Flow refers to the game's organization and mechanics to enable a player to become immersed in the experience. Sensory/imaginative immersion is the game's ability to pull participants into the experience and away from the world around them. Competence is the confidence and success the player has while playing. The questions are designed to identify how engaged the player is during the experience, to identify both positive and negative emotions the player may have experienced, and to determine if the game design added or took away from the overall experience.

Results

This chapter reviews the results from the research conducted to gain a better understanding of the newly formed partnership between MCS/BSU and the needs of the stakeholders involved. It reviews the rapid, iterative design process and the results of the testing from each prototype. The results for *Aha! The Game* used during the design thinking sessions are reviewed.

Empathy Research

The empathy research conducted for this thesis project included interviews with eight key stakeholders and participant observations from three public events in Muncie, Indiana, in June 2018. Analysis of interviews, observations, and feedback resulted in eight key themes that reflect the hopes and concerns of the stakeholders: quality education, MCS management, MCS support, BSU programs, community partnerships, the positive benefits of the partnership, the perspective of Muncie's future, and BSU's new role. More detail on the feedback gleaned from stakeholders for each theme is below:

1) Quality education: The stakeholders suggested that achieving educational excellence could include choosing the right curriculum, instituting a balanced calendar, reducing the student course load, and providing academic enrichment programs. Many of the stakeholders recommended recruiting educated volunteers to provide academic enrichment to students through a mentoring program.
2) MCS management: Some stakeholders reported that it was important for the school board and MCS/BSU leadership to send outreach representatives to every building to observe, ask

questions, and report findings to BSU. Thus, it's clear that the university needs to fully understand the MCS culture before making changes.

3) Teacher, staff, and administrative support: Stakeholders expressed the need to support teachers by listening and establishing relationships with them. Suggestions to support teachers included providing on-site child care, increasing the teachers' compensation, and reducing out-of-pocket expenses for teachers.
4) BSU programs: Some stakeholders shared ways BSU is already helping MCS, and they wanted this partnership to continue and expand. Others were excited for BSU to bring additional resources to MCS. Stakeholders said they hoped to see early childhood education and programs implemented to achieve school readiness by age five. Teachers would like additional training on using and teaching technology.
5) Community partnerships: Stakeholders indicated that Muncie's economy has been affected negatively since the closure of factories. Teachers, administrators, and staff need to understand how poverty in the Muncie community affects families and their decisions to approach the parents and teach the children more effectively. Stakeholders suggested offering events and programs to strengthen the sense of community within Muncie.
6) Positive benefits of partnership: Many stakeholders said they believe building trust between BSU and MCS is critical to the success of the partnership. BSU needs to cautiously approach this relationship with MCS and promote confidence in MCS's future stability. The university needs to create a central narrative that engages the parents and community. The positive aspects of MCS need to be recognized without ignoring the challenges being experienced by the residents of South Muncie.

7) Perspective of Muncie's future: When asked about the future of Muncie, stakeholders expressed mixed emotions and different viewpoints. Most said they believe the partnership will be a healthy and positive change. Others were worried and curious about the unknown. The stakeholders with positive views were excited that BSU could bring cutting-edge knowledge and educational expertise to the table. One stakeholder thought BSU was a good choice because it's a local solution that is familiar with the community rather than a distant management solution.
8) BSU's new role: When asked about how BSU should handle its new role, many stakeholders expressed concern that BSU might fail in its new role. They said that it's important to talk to the community members, teachers, administrators, and parents to understand their feelings and needs. One stakeholder stressed the importance of students being the main focus of projects and solutions that arise from the BSU partnership. Another stakeholder expressed fear that BSU will fail to resolve the challenges being experienced by the MCS district, and it will actually lead to the community developing mistrust in BSU.

Iterative Game Design

The rapid, iterative design process for *Aha! The Game* ranged from slight to significant change with each prototype. Prototypes One, Two, and Three were tested with users. Prototype Four was tested in one cognitive walkthrough with an expert in user experience design and a second cognitive walkthrough with a key stakeholder. The final prototype was used in the design thinking sessions with MCS teachers.

Round One: Game Prototype One – Trivial Pursuit Format

The players reported that the first prototype involved excessive game mechanics. The mechanics involved in gameplay included moving around a board, rolling the die, collecting pie pieces, drawing prompt cards, writing the answers to the prompts on paper, halting individual play for a team activity, and voting on what they believed to be the best answers from their peers. The players reported feeling confused and overwhelmed by the number of requirements, which negatively detracted from their overall experience. Players also responded positively to the game concept and objective. They enjoyed sharing information about the EMDD program with the other players. With the feedback learned from the users, the goal for the next prototype was to reduce the number of mechanics used in the game.

Round Two: Game Prototype Two– Board Game Format

During the usability testing of the second prototype, there was limited player interaction. Players reported feeling bored and wishing the gameplay would end. They were unclear about the game's objective, and they felt the game lacked enjoyment because it lacked a competitive value. They reported that the prompts were repetitive, and at times, uninteresting. Players enjoyed halting play for the *Bus Stop* questions, reporting that they enjoyed the break and liked interacting with their peers. With the feedback learned from the users, the goal for the next prototype was to clarify the game's objective, add a competitive element to the game, improve the variety of the game prompts, and reduce repetitiveness by eliminating board play.

Round Three: Game Prototype Three – Card Game Format No. 1

Prototype Three was reduced to a card game with a color-coded die. Players took turns playing, which forced increased interaction with peers. Since the questions were read aloud

before players recorded their answers, the same questions were repeated more than once. Several players were heard saying, “This question was just asked, and I don’t really have anything new to add to the previous answer.” The users enjoyed playing the game and did not experience boredom. The feedback learned from the usability testing suggests that the team had eliminated barriers to interaction and created more interesting gameplay. Prototype Four needed to retain the player interaction but eliminate the repeating questions. This was accomplished by creating a community deck that is passed from player to player. All players still answered all questions by recording their answers on an individual game pad.

Game Prototype Four and Final Prototype

Prototype Four retained features that tested well in Prototype Three like player interaction and card play without a board. By condensing the cards into one deck that rotated from player to player, the same questions were no longer read more than once. This prototype was tested by conducting a cognitive walkthrough with one expert in user experience design. No major flaws were found in this walkthrough.

During the second walkthrough with a key stakeholder, the suggestion was made to combine the *Bus Stop* questions with the community deck of cards. The *Bus Stop* questions were fun questions that would get the game started with high energy. The final prototype included a community deck of cards with three categories of questions that built on each other. Players started with big dreams, then considered the processes needed to implement the big dreams, and ended with identifying the resources needed for the big dreams. To eliminate the need for a slotted sorting tray, corresponding numbers were added to the cards and the answer sheet. This prototype was the final version and was used during the design thinking sessions.

Results for Aha! The Game

Aha! The Game generated 2,547 data points from 98 participants. This is an average of nearly 26 data points per participant. The EMDD graduate team distilled all of the data points from the design thinking game into seven key themes, which are outlined below:

1) Teacher Needs and Academic Improvement: Nearly one-third of responses indicate educators would like increased support in the following areas: prep time, class schedule, additional aides and assistant teachers, smaller student-to-teacher ratio, and sensitivity to teachers' needs from administration. Staff are also interested in developing innovative curricula, increasing academic performance, exploring non-traditional instruction, initiating field trips, and creating individualized curriculum plans for students.
2) Technology Improvements and Support: Teachers indicate that Muncie Community School system suffers from a lack of technology. The technology the school system currently owns is unreliable and outdated. Feedback from educators identifies a need for digital literacy to be taught in the classrooms. Teachers also express a desire for training on how to use technology and how to better integrate technology in the classroom.
3) Facility Improvements and Other Resources: Responses indicate that facility improvements and resources are important areas to be addressed. Facility improvements include more classroom space, flexible seating, more storage, an assessment of safety, and enclosed classrooms. Educational resource needs include basic classroom supplies, books, and hands-on learning activities. Students need equal opportunities and access to resources like clothing, school supplies, and food.

4) Community Engagement: Responses indicate a desire to experience more community assistance. Ideas generated focus on community members and businesses investing through classroom visits and mentorship with students. In addition, educators would like the community to have a positive image of Muncie Community Schools by transforming the school system to be collaborative, supportive, innovative, compassionate, caring, welcoming, and impactful on student and teacher lives.
5) Behavior Management and Positive Environment: A consistent theme in all the schools is to improve behavior management and create a more positive, safe school environment. Educators desire teaching engaged, motivated students who are compliant to the rules and expectations in the classroom. Educators recognize the need for specialized training in trauma to reduce disruptive student behavior during the school day. A reduction of disruptive behavior would improve the environment of the school for all students and educators.
6) Financial Stability: Educators express the need for financial stability in the school. Financial stability enables access to adequate resources to address the identified needs in this report. Additionally, by providing competitive salaries and benefits, quality educators will be attracted and stay in the school system. Financial stability would boost morale in the school system and community.
7) Parent-Involvement and Extracurricular Programs: Educators agree that increasing parental involvement in the classroom and in the students' lives would benefit the educational process. An additional benefit to the educational process would be to increase extracurricular programs. Increasing extracurricular programs would broaden the students' experiences.

The themes were validated by MCS teachers in a follow-up session. Teachers were given a Likert-scale survey with 12 statements. The five-point scale ranged from not important (1) to very important (5). Teachers ranked 11 of the 12 statements as a 4 on a 5-point scale. The only exception to this is the theme "Resources," which received a 3.8. The results from this survey confirm that the data gathered through *Aha! The Game* was valid (see Appendix J).

Game Experience Questionnaire

The game experience questionnaire measured input from game participants regarding their experience while playing *Aha! The Game* (see Figure 5).. The questions elicit the participant's feedback on the overall experience, the game's effect on their emotional state like annoyance or confidence, and how the game itself positively or negatively contributed to the experience. Participants indicated that their tension or annoyance while playing the game was low (0.229 mean on a 4.0 scale). Very few participants considered playing *Aha! The Game* a negative experience (mean of 0.303). The challenge was viewed by participants as relatively low (mean of 1.158). This could be considered a negative result if the game is too simplistic to create engagement; however, participants reported their sensory/immersion during the game as moderately high (mean of 2.750). Participants reported their competence level as moderately high as well (mean of 2.783), which would suggest that they were confident navigating the game mechanics and/or the subject content of the prompts. Flow of the game was reported as somewhat low (mean of 1.841), which could indicate the game's organization should be evaluated as a source of distraction to players. Overall, participants reported the gameplay as a positive experience (mean of 2.382).

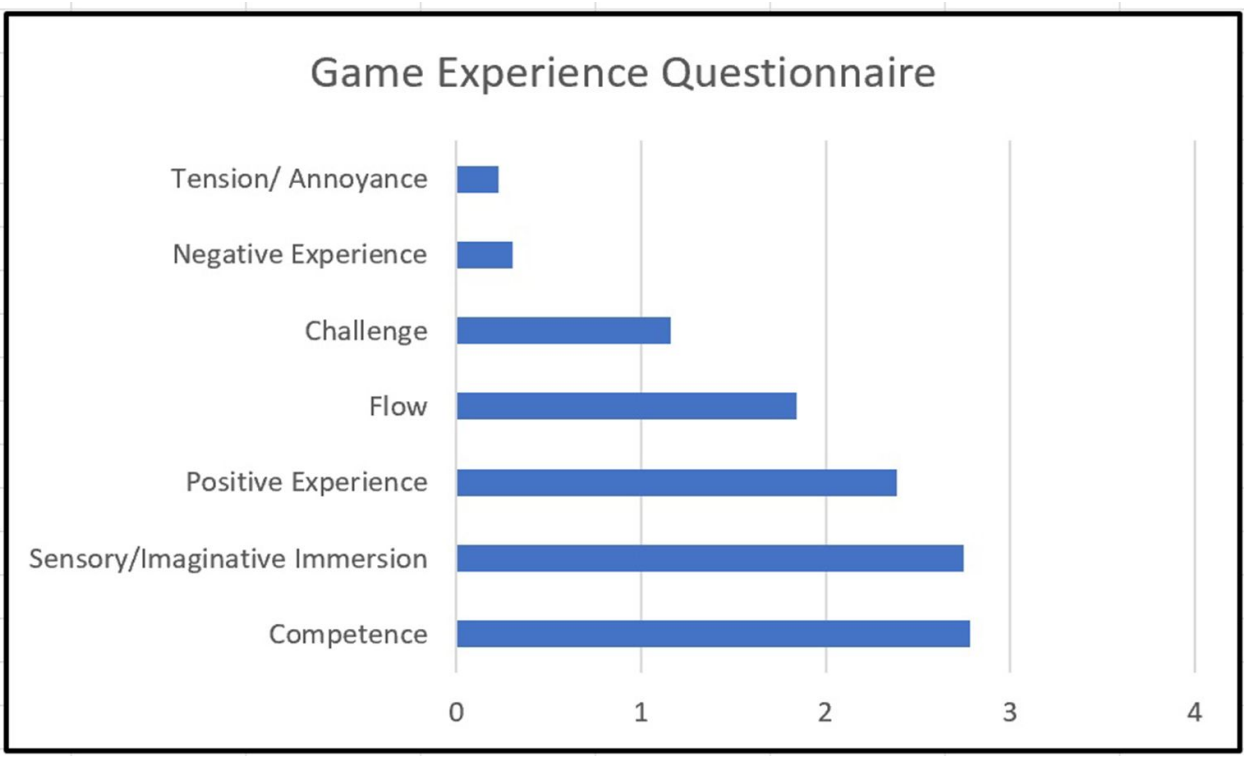

Figure 5. Game Experience Questionnaire Results: Scale measurement is on a Likert scale of 0 to 4 scale (0 = not at all, 1 = slightly, 2 = moderately, 3 = fairly, 4 = extremely). Tension/Annoyance (0.229 mean on a 4.0 scale, n =81); Negative Experience (0.303 mean on a 4.0 scale, n = 81); Challenge (1.158 mean on a 4.0 scale, n = 81); Flow (1.841 mean on a 4.0 scale, n = 81); Positive Experience (2.382 mean on a 4.0 scale, n = 81); Sensory/Imaginative Immersion (2.750 mean on a 4.0 scale, n = 81); Competence (2.783 mean on a 4.0 scale, n = 81)

Discussion

This thesis chronicles the development process of *Aha! The Game*, a design thinking game created specifically for Muncie Community Schools. The case study explores whether tools like *Aha! The Game* can engage participants by increasing their motivation to participate in a design thinking activity. This involves introducing game mechanics into a design thinking exercise. The case study explores whether the game is capable of producing nuanced ideas from teachers. Finally, the case study looks at whether design thinking games can be used in other problem spaces.

Aha! The Game was developed using a rapid, iterative design process. Before the research team began facilitating design thinking with MCS teachers, the game went through five rounds of development and testing. After gathering 2,547 data points from the final game iteration alone, the research team categorized these responses into seven key themes. This provides a strong foundation for MCS to begin working toward solutions to address the challenges that teachers so cogently identified in the design thinking process.

Summary of the Development Process

Ironically, design thinking is what led the EMDD graduate team to create a design thinking game for teachers. They started the design thinking process by framing the question: How might we create a fun, engaging experience to elicit feedback for BSU from MCS teachers? Next, they conducted empathy research to learn how teachers are feeling about the MCS/BSU partnership and what teachers believe they need. To conduct the research, the team went to public forums, had informal conversations with teachers inside and outside of MCS, and

interviewed parents and teachers to become thoroughly familiar with the situation and the perspectives of the key stakeholders.

After becoming thoroughly acquainted with the unique MCS/BSU partnership and understanding the stakeholders' reactions and expressed needs, the team was ready to begin the idea generation process. The priority of the design thinking sessions with teachers was to gain valuable feedback from MCS teachers for BSU. Even if teachers reported negative feelings about the partnership, it was important to motivate their engagement and keep their focus on providing constructive feedback. The design thinking tool had several requirements: provide a fun experience to engage teachers, produce a large quantity of ideas, and accurately represent the teachers' perspectives.

The team generated dozens of ideas before deciding a game experience that facilitated design thinking could potentially meet all the requirements. A quick prototype was created to test with the first group of users. After gaining valuable feedback, the team returned to the design lab and created another prototype. The team created and tested four prototypes using a rapid, iterative design process before creating *Aha! The Game.* The final version of the game contained a deck of 12 cards with design thinking prompts, game sheet pads, two baskets to place winning answers and other answers, and Apple tokens to track the winner for each round. The game was fun and competitive without being overly complicated. It inspired participants to dream with the first four prompts. It then moved participants to think about how to actually implement those big dreams and ended with exploring how to gain the right resources for the dreams. Without the participants being aware, it created a very effective structure to avoid providing too much direction for the ideas but also prevented the ideas from being too broadly scattered.

Research Question 1: Evaluation of Participant Motivation in Design Thinking

This case study evaluates whether a design thinking game could increase motivational tactics in the design thinking experience and could result in greater engagement of the participant. Thus, to evaluate the game's success in motivating greater engagement in the design thinking activity, the first place to examine is the amount of ideas generated. Each design thinking session was 90 minutes; however, the game experience was only half of the session. In 45 minutes, participants generated approximately 26 data points per person. Approximately, every two minutes an idea was being generated by each individual. This demonstrates a high level of involvement of the participants in the design thinking experience. The largest of the 10 design thinking sessions was attended by 26 individuals. This would mean during the 45 minutes of gameplay, participants generated 676 data points.

For 15 minutes of the 90-minute session, teachers were asked to participate in a SWOT analysis activity. This activity produced 610 responses from 98 teachers. On average, each teacher provided approximately six answers during the 15-minute activity. This produced 28% less responses per minute than *Aha! The Game.* Comparing *Aha! The Game* to a verbal brainstorming activity, in order to yield similar results to the game, participants would need to verbalize 15 responses every minute for 45 consecutive minutes. It would obviously be impractical, if not impossible, to verbalize that many responses in the provided time. It is reasonable to conclude that the design thinking game is far more effective at generating numerous data points than a SWOT or verbal brainstorming activity without game mechanics would be.

Aha! The Game clearly motivates participants to contribute a lot of responses during the gameplay. Since pleasure is often a motivation for some individuals to participate in an activity, it could be assumed that pleasure contributed to the increase in responses with the game. To determine whether pleasure was present during gameplay, it was important to determine whether participants would consider playing *Aha! The Game* a positive experience. A positive or negative experience can have a major effect on how well humans are able to perform tasks (Norman, 2005). When a task is difficult, negative affect focuses the mind to lead to better concentration. Problem solving leads to a narrow, tunnel vision. Positive affect broadens the thought processes and results in creative, out-of-the-box thinking. Introducing pleasure into the design thinking experience could prevent the process from becoming too formulaic. Gamification is one way to ensure playfulness is a part of the design thinking process. It begins by establishing a cooperative agreement among players, which is important in a creative problem-solving activity.

To measure whether pleasurable emotions resulted from playing *Aha! The Game*, participants were given a game experience questionnaire after the game finished. The results from the questionnaire demonstrate that most participants considered the game a positive experience, reported a sense of competence, and were immersed in the experience. It is clear that most of the participants experienced a sense of pleasure while playing the game. In most cases, pleasure would increase engagement, which could point to a high level of motivation to create 2,547 data points from *Aha! The Game*.

Research Question 2: Evaluation of Nuanced Ideas

This case study evaluates the quality of answers generated by *Aha! The Game* to determine whether it is possible to create nuanced ideas from a design thinking activity. One

criticism of design thinking is that its formulaic process lacks the ability to create truly innovative ideas (Iskander, 2018; Jen, 2018; Nussbaum, 2018; Walters, 2011). Solutions generated from design thinking could fail to consider the complexity of the problem it is addressing. Critics would say that a more nuanced idea might come from a more qualified expert or designer. A typical teacher might come up with the less creative ideas due to their narrow exposure to the challenges of a distressed school district or their lack of training to address the complexities of leading an entire school district. Norman (2019) advocates that although having an expert's opinion is important, it is equally important to receive bottom-up input to yield the best results. This could be especially true in an educational environment where teachers have the most face-to-face contact with the students.

Evaluating the data from *Aha! The Game* suggests that the MCS teachers across 10 schools in the district were in agreement with the seven challenges facing the district. Teachers related stories of real students, which humanized the problems that were being discussed. Many of the teachers expressed that there was a problem with the family system outside of the school doors. A common suggestion was for the schools to provide family support and parent mentoring to better prepare students to learn during school hours. Poverty was blamed for creating obstacles to learning. At all 10 schools, teachers contemplated ideas to fix the lack of resources in students' lives like food, clean clothing, comfortable shoes, and school supplies. The themes generated by teachers represented the nuanced complexities of the challenges facing MCS. Since these results in 10 separate design thinking session were consistent, it strongly suggests that idea generation from this type of game could result in nuanced themes.

Future Work: Using Design Thinking Games in Other Problem Spaces

Further research could explore the efficacy of a design thinking game in other problem spaces beyond the MCS district. There are few, if any, games like *Aha! The Game* being used to facilitate design thinking in educational settings. However, it is important to note that there are struggling school systems across the country that are grappling with some of the same challenges faced by Muncie Community Schools, including (but not limited to), budget shortfalls, inadequate access to technology for teachers and students, low teacher salaries, outdated and run-down facilities, disciplinary problems, and more. Thus, there is clear potential for a design thinking tool like *Aha! The Game* to be used in other environments, and the game could empower teachers with a voice to affect change in education. This bottom-up input (Norman, 2019) from teachers who directly educate students and are familiar with the daily challenges this involves could be a powerful tool when combined with the top-down expertise (2019) of a school district's administrative leadership.

This case study explores a new design thinking method of using game mechanics combined with the design thinking framework to increase the motivation for participant engagement and the quality of idea generation. *Aha! The Game* shows promising signs for using the game in other educational environments. The prompts can be customized to address a different problem space without changing the gameplay. It is worth noting that a similar idea generation game, *Pick-A-Prompt*, yielded significantly improved results in a corporate setting with scientists and engineers. Using the game yielded more than a 700% increase in idea quantity. One of the ideas generated by this game yielded the corporation a multi-million dollar idea.

It is important to consider that *Aha! The Game* was the result of using a design thinking process to create a solution to gather meaningful data from MCS teachers to guide MCS/BSU leadership to draft the *Academic Innovation and Financial Viability Plan* to be presented to the Indiana legislature in June 2020. To use a design thinking game for a different problem space, the same design thinking process is needed to ensure the right solution is created. In cases where a design thinking game is an appropriate solution, the stakeholders' needs should influence the design of the game. The prompts to ask would vary based on the problem space being addressed. In the case of *Aha! The Game*, the solution seems to be an excellent fit for the needs of the MCS teachers and yielded the right amount and type of data for the MCS/BSU leadership.

Conclusion

This case study explores a single design thinking game used in a distressed school district; and therefore, a pattern for the efficacy of design thinking games has not been established in this paper. Although gamification is widely used in organizations, using game mechanics within the design thinking framework is not a common practice. As a result, there is limited data available to confirm that introducing game mechanics into a design thinking exercise increases the motivational tactics used in the design thinking framework to engage participants. Design thinking has been criticized for not generating nuanced ideas. The development process for *Aha! The Game*, as well as the game itself, used design thinking. Both applications of design thinking clearly demonstrate the framework can create nuanced ideas; however, if facilitators make the mistake of removing playfulness from the process, creative, nuanced ideas will be limited (Schwab, 2018). The development process for *Aha! The Game*

strongly supports that a nuanced design thinking process that considers the complexities of the problem space creates a nuanced outcome.

This thesis presents a solid case for using design thinking games in distressed schools. It also provides a second example of using a design thinking game in a scientific organization. Both examples motivate the participants to be creative, and both yield an impressive quantity and quality of ideas. This evidence would merit further exploration whether using design thinking games in other environments would produce similar results. Further research on the relationship of a game experience's engagement and immersion on the creative output in design thinking idea generation is merited.

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Appendix A. Stakeholders' Interview Questions

1) How are you currently involved with Muncie Community Schools?
2) As a [role of the stakeholder], describe your thoughts about the future of Muncie Community Schools and why you feel this way.
3) If stakeholder expresses concern, then ask: how could these concerns be addressed?
4) How have you personally been affected by the recent developments with Muncie Community Schools?
5) Has Muncie Community Schools affected your personal life in a positive way? If so, can you please share your story?
6) In Ball State's new role, what changes would you like to see in the Muncie schools?
7) How do you expect Ball State to change as a result of its new role with Muncie schools?
8) Have you been directly involved with Muncie schools, its students, or programs; if so, how were you involved?
9) How do you think the Teachers College can change Muncie schools?
10) What are the achievements that Muncie Community Schools have accomplished?
11) How should Ball State handle its new role in Muncie schools?
12) What are some ways that Ball State can improve and/or support Muncie schools?
13) How do you feel about Muncie schools in general, and would you like to feel differently about the system?
14) How can local businesses and community members engage in this new partnership with Muncie Community Schools?

Appendix B. Design Thinking Game Prototype One Prompts

ORANGE How might we create the ideal low-res EMDD program?

- If I managed the low-residency EMDD program, I would _(insert big idea)___?
- If there were no financial constraints for the low-residency EMDD program, I would __ (insert big idea)___?
- Write down three quick ideas to this question: How might we create the ideal low-residency EMDD program?
- FREEZE! Stop what you're going, grab the timer, yell freeze to your teammates, and read the following instructions. "Stop what you're doing, everyone go around the table and answer this question: How might we create the ideal low-residency EMDD program?

PURPLE What is one immediate change that you would make today to the low-res EMDD program?

- If I were to make one immediate change in the low-residency EMDD program, I would _(insert big idea)___?
- Write down three quick ideas to this question: What immediate change would improve the low-residency EMDD program?
- FREEZE! Stop what you're going, grab the timer, yell freeze to your teammates, and read the following instructions. "Stop what you're doing, everyone go around the table and answer this question: What is one immediate change that you would make today to the low-residency EMDD program?

GREEN How might we better promote the low-residency EMDD program?

- If I were in charge of marketing, I would ___(insert big idea)_____ to promote our program?
- If there were no financial constraints for the low-residency EMDD program, I would __ (insert big idea)___ to promote the program?
- Write down three quick ideas to this question: How might we better promote our program?
- FREEZE! Stop what you're going, grab the timer, yell freeze to your teammates, and read the following instructions. "Stop what you're doing, everyone go around the table and answer this question: How might we better promote our program?

Appendix C. Script for Game Prototype Two

Facilitators say: We are going to spend the remainder of our time together playing a game that will hopefully inspire you to Dream Infinitely. Gather in groups of four around a game board on the table. You each will find your own pawn, a die, a set of cards, and a game sheet. The game has four rounds, and we will give instructions before each round. Let's get started!

Rules for Round 1:

1) Roll your own die.
2) Move your game piece.
3) If you land on blue, pick up a blue card. If you land on a green, pick up a green card, etc.
4) Write your answer on that card.
5) Roll again.
6) During the game, we will call out to halt the game play. These *Bus Stop* cards will give you a bonus question to answer that will automatically enter you in a drawing for a prize.
7) We will play for 20 minutes.
8) You may not have enough time to answer all of the questions during the game and that's okay.

Bus Stop:

1) It is a time for a *Bus Stop*! [pass out cards]
2) Spend one minute in self-reflection starting now.
3) Go ahead and take the next two minutes to share your answers with those at your table.
4) We will be passing a basket for you to place your card in and will be drawing for a prize for your entire table. [Gather cards and draw the prize winner. Distribute prizes to their table.]

Rules for Round 2:

1) Look at your answered cards and choose your 2 favorites.
2) Rate your answer from 1 (just okay) to 5 (outstanding).
3) Place your rating on your card on the first line.

Rules for Round 3:

1) Pass your 2 favorite ideas to the player on your left.
2) Players rank the cards passed to them from 1 (just okay) to 5 (outstanding).
3) Write the rating one of the lines on the card.
4) Pass the cards again until your own cards return to you.

Rules for Round 4:

1) Total all the numbers on your card.
2) Write that number in the box.

Facilitators say: Next we're going to share the top answers. If you have a 25 in the box, please come stand up here. If you have 24 in the box, please stand up here, etc. (Stop when we have at least ___ people standing.) Now, could everyone standing please read your card? Let's start with the highest rating?

That concludes our session. As a thank you, please take a parting gift.

Appendix D. Design Thinking Game Prototype Two Prompts

Each set of game cards is assigned a color that coordinates with the space colors on the game board. The space colors include blue, green, orange, yellow labeled with *Bus Stop*, and white labeled with "Free Play."

BLUE Theme: Inside the School (education, specials, technology, etc.)

- Fill in the Blank: My school should offer _____ in our classrooms.
- Fill in the Blank: Technology could enhance students' learning in my classroom by _____.
- Answer with 1-3 words: If it were up to me, I'd add the following into our school: __ __ __
- Answer with 1-3 words: In a dream world with no budget constraints, I would add this to my classroom. ___ ___ ___
- Write down one idea: What tool could help improve my ability to teach?
- Write down one idea: Where would I like to see my school in 5 years with the help of Ball State?

GREEN Theme: Outside the School (community, partnerships, etc.)

- Fill in the blank: Ball State Teachers College could provide my classroom with _____.
- Fill in the blank: If college students donated their time to my classroom, I'd ask them to ____.
- Answer with 1-3 words: In five years, I would like the community to be able to partner with my school in this way. ___ ___ ___
- Answer with 1-3 words: I wish Ball State could fulfill this dream for my school: ___ ___ ___
- Write down one idea: If a community partner asked me what I needed for my classroom, this would be my first request. _____
- Write down one idea: A community partner could help make this immediate change in my school. _____

ORANGE Theme: Uniqueness of each school

- Fill in the blank: My school is unique because _____.
- Fill in the blank: My classroom is different from other schools' classrooms because ____ ____.
- Answer with 1-3 words: In five years, if someone asked me about my school, I'd want them to describe it with these words. ____ ____ _____

- Answer with 1-3 words: We should continue to explore these areas to set our school apart from others. ____ ____ ____
- Write down one idea: This is what I would like my school to be known for in the community. _____
- Write down one idea: How can I make my classroom different than other schools' classrooms?

YELLOW Two *Bus Stop* Cards

- Think back to when you were a student. What did your favorite teacher do to inspire you? _____
- If you could create a dream classroom, what would it look like? _____.

Appendix E. Prompts for Game Prototype Four

YELLOW Theme: Inside the School (education, specials, technology, etc.)

- Fill in the Blank: Technology could enhance students' learning in my classroom by _____.
- Answer with one statement: In a dream world with no budget constraints, I would add this to my classroom. ___ ___ ___
- Write down one idea: What tool could help improve my ability to teach?
- Write down one idea: Where would I like to see my school in 5 years with the help of Ball State?

GREEN Theme: Outside the School (community, partnerships, etc.)

- Fill in the blank: If college students donated their time to my classroom, I'd ask them to ____.
- Answer with one statement: In five years, I would like the community to be able to partner with my school in this way. ___ ___ ___
- Answer with one statement: One thing I wish people knew about my school is: _____
- Write down one idea: "Ball State could help fulfill this dream for my school, in this way: _____."

RED Theme: Uniqueness of each school

- Fill in the blank: My school is unique because _____.
- Fill in the blank: My classroom is different from other schools' classrooms because ____ ____.
- Answer with one statement: In five years, if someone asked me about my school, I'd want them to describe it with these words. ____ ____ _____
- Answer with one statement: We should continue to explore these areas to set our school apart from others. ____ ____ ____

YELLOW-ORANGE Theme: *Bus Stop* Card

- Think back to when you were a student. What did your favorite teacher do to inspire you? _____
- If you could create a dream classroom, what would it look like? _____.

Appendix F. Instructions for Game Prototype Four

Players:

- 4 players per team
- One person is a judge and that position rotates per

Objective:

- Gather as many "apples" as you can in your group. The person with most apples from each group wins a prize.

How to Play:

- Sit in groups of 4.
- Place the 12-slotted holder in front of one person. This person is the judge for the first round.
- The judge shuffles the cards and picks up one of the community cards and reads it to their group.
- The other players have one minute to write down their answer on the their pad of paper.
- The players give their papers to the judge once they're done.
- The judge reads the three ideas and chooses one winner.
- The judges places an apple sticker on the winning card.
- The judge reads the winner's answer out loud.
- The winner receives an "apple eraser."
- The judge places the three answered cards into the correct spot in the 12-slot holder. (i.e. If it was question 2, place it in the slot that has the card with the 2 on it.)
- The person to the left of the judge becomes the new judge for the next round.
- Once all 12 questions are answered, the game is over.
- The person in each group with the most "apples" wins a prize.

Bus Stop Round

- The deck of cards contains 2 *Bus Stop* cards. If drawn, each player, including the judge, draws a blank *Bus Stop* card from the middle.
- The "judge" reads the question on the *Bus Stop* card. All players write an answer to the question on their *Bus Stop* card.
- The players put their *Bus Stop* cards in a bucket for a prize drawing. The cards are numbered either 1 or 2 so we can later determine which answers went with the 2 *Bus Stop* questions. These answers will not be ranked.
- At the end of the game play, prize winners are drawn from the *Bus Stop* bucket.
- We read the answers out loud and ask for the winner so they can receive their prize.

Appendix G. Prompts for Game Prototype Five

YELLOW Dream Big Questions

- If I could create a dream classroom, what would it look like?
- Where would I like to see my school in five years with the help of Ball State?
- What are things I dream about for my school?
- In five years, if someone asked me about my school, I'd want them to describe it with these words.

GREEN What processes do we need in place to fulfill the big dreams?

- We should continue to explore these areas to set our school apart from others.
- One way our school could foster a unique quality or talent in a positive way is by _____
- I would like the community to be able to partner with my school in this way.
- To fulfill my dream classroom, I would need assistance from _____.

RED What resources do we need to have to fulfill the big dreams? (red cards)

- Technology could enhance students' learning in my classroom by _____.
- This resource would be most helpful to my students' success in class.
- If volunteers donated their time to my classroom, I'd ask them to ____.
- In a dream world with no budget constraints, I would add this to my classroom.

Appendix H. MCS Design Thinking Session Script

INTRODUCTION

- Everyone starts seated at tables
- Dr. Buck/Andrew open the session with a 5-minute introduction
- EMDD team introductions: Amy, Debbie, Kate

Script
(If we need to rearrange groups for the sake of numbers, do it now. 4-6 per table.)
Before we get started, we're going to even out the teams...

Today, during the first half of our session we will start with an exercise to identify your school's strengths, weaknesses, opportunities, and threats. This exercise is called a SWOT analysis.
If you look around the room, you will see easels marked with the words strengths, weakness, opportunities, and threats. The strengths and opportunities are things that are helpful to achieving your objectives as educators. The weaknesses and threats are things that are or could become harmful to your ability to achieve your objectives as educators.

Everyone, grab the sharpie, pad of Post-it notes, and stickers in front of you. Now, look at the number on your table and find the easel with the corresponding number. Take your sharpies, Post-its, stickers, and gather around your easel.

SWOT Script 1 (for 8 or less participants)
All participants are placed around 2 easels that contain the Strengths

Round 1
Please think of as many ideas as you can that correspond with the topic for the station your are at. Limit your answers to one idea per Post-it note. Then, place the Post-it on the easel. You will have 2 minutes to respond to the prompt before you will be asked to shift to the next easel.
Ready, go!

[2 minutes]

Great work everyone! Now, take the stickers we have provided you and place a sticker on the three ideas you think are most important and/or valuable. You have 1 minute to do this.

[1 minute]

Alright, now rotate right to the next category.

Round 2:
Please write one idea per Post-it note, placing each Post-it on the easel as you go. You will have 2 minutes to respond to the prompt before we move onto the next easel. Ready, go!

[2 minutes]

Great work everyone! Now, take the stickers we have provided you and place a sticker on the three ideas you think are most important and/or valuable. You have 1 minute to do this.

[1 minute]

Alright, now rotate right to the next category.

Round 3:
You now have two minutes to respond to the prompt you see at this easel. Ready, go!

[2 minutes]

Great! Now, place a sticker on the three ideas you think are most important and/or valuable. You have 1 minute to do this.

[1 minute]

Alright, now rotate right to the next category.

Round 4:
You now have two minutes to respond to the prompt you see at this easel. Ready, go!

[2 minutes]

Great! Now, place a sticker on the three ideas you think are most important and/or valuable. You have 1 minute to do this.

[1 minute]

We will now take a 5-minute break. But, before we do so, we'd like to share a project with you.

We are also working on a project in collaboration with the Professor Garfield Foundation to support teachers in teaching K-5 students about digital literacy across the curriculum, with an emphasis on reading and language arts. We are in the process of building some free resources, a new professor Garfield website, and professional development opportunities for K-5 teachers. As we develop those offerings, we would like to consult with K-5 teachers to get valuable feedback and advice. If you are interested in learning more about that project, please fill out the handouts with your contact information so that we can reach out to you and share more information at a later date.

Please return to your original table after the break.

SWOT Script 1 (for greater than 8 participants)
All participants are placed at 1-2 easels that contain the S, W, O, and T

Round 1
Please think of as many ideas as you can that correspond with the topic for the station your are at. Limit your answers to one idea per Post-it note. Then, place the Post-it on the easel. You will have 2 minutes to respond to the prompt before you will be asked to shift to the next easel. Ready, go!

[2 minutes]

Alright, now rotate right to the next category.

Round 2:
Please write one idea per Post-it note, placing each Post-it on the easel as you go. You will have 2 minutes to respond to the prompt before we move onto the next easel. Ready, go!

[2 minutes]

Alright, now rotate right to the next category.

Round 3:
You now have two minutes to respond to the prompt you see at this easel. Ready, go!

[2 minutes]

Alright, now rotate right to the next category.

Round 4:
You now have two minutes to respond to the prompt you see at this easel. Ready, go!

[2 minutes]

Great! Now, move around the room to the different easels and place a round sticker on the three ideas in each category (strengths, weaknesses, opportunities, and threats) that you think are most important and/or valuable. You have 5 minutes to do this.

Game Script

Now that we have identified your school's unique strengths, weaknesses, opportunities, and threats, we are going to play a game to help you brainstorm the aspirations that you have for your school and students. This game is designed to get you out of your comfort zone, so think big and share your wild ideas.

After all of our sessions with the Muncie Community Schools, we will be developing a website where the top ideas, voted on by you, will be displayed.

Let's get started.

The objective of the game is to gather as many "apples" as you can. (Hold up apple.) The person with the most apples from each group at the end of the game will win a prize.

Let's walk through how to play.

During each round, one of you will be the judge. If you have a deck cards in front of you, please raise your hand. You are the judge for the first round.

Judges, please draw a card from the deck. Read the question to the players.

Now, everyone grab your answer sheet. All players, including the judge, should write your

answers on your answer sheet. You have 2 minutes to write down your answer. Be creative. The judge will rank your answers.

Your time begins now!

[2 minutes]

Time is up! Give your answer sheets to your judge.

Judges, you now have 1 minute to read all of the answers out loud and choose your favorite answer. You cannot choose your own answer. If there are multiple answers, circle the answer you like best. Your time begins now!

[1 minute]

Time is up!

Judges, please check the box on the answer sheet for the idea you liked the best and give the person who came up with the idea an apple.

Now judges, please place the answer sheets in the bins on the table and give the deck of cards to the person to your left. That person is now the judge for the next round. The judge rotates every round.

Now you can begin round 2. In 9 minutes you should be done with first set of 4 cards. We will let you know when 9 minutes is up.

(9 mins has passed.)

You should now be on question 5 which is a green card.

(12 mins has passed.)

You should now be on question 9 which is a red card. We will play for another 12 minutes.

(9 mins has passed.)

There is another 3 minutes left in the game.

(After Round 12:)
Please count the number of apples you received. The person at each table with the most apples is the winner. Winners, please raise your hands.

Congratulations! We'll give you a bag, and you can go to our prize bins and choose 8 items to place in your bag.

As our last part, we're going to pass around a survey asking about your experience with the Aha! Game. This survey will help us assess the effectiveness of the game for our graduate research. It is completely voluntary. On top of the survey, is a consent form as well. Thank you for your time today.

Appendix I. Game Experience Questionnaire

Game Experience Questionnaire – Core Module

Please indicate how you felt while playing the game for each of the items, on the following scale.
Please circle your answer.

1. I felt content	not at all	slightly	moderately	fairly	extremely
2. I felt skillful	not at all	slightly	moderately	fairly	extremely
3. I thought it was fun	not at all	slightly	moderately	fairly	extremely
4. I was fully occupied with the game	not at all	slightly	moderately	fairly	extremely
5. I felt happy	not at all	slightly	moderately	fairly	extremely
6. It gave me a bad mood	not at all	slightly	moderately	fairly	extremely
7. I thought about other things	not at all	slightly	moderately	fairly	extremely
8. I found it tiresome	not at all	slightly	moderately	fairly	extremely
9. I felt competent	not at all	slightly	moderately	fairly	extremely
10. I thought it was hard	not at all	slightly	moderately	fairly	extremely
11. It was aesthetically pleasing	not at all	slightly	moderately	fairly	extremely
12. I forgot everything around me	not at all	slightly	moderately	fairly	extremely
13. I felt good	not at all	slightly	moderately	fairly	extremely
14. I was good at it	not at all	slightly	moderately	fairly	extremely
15. I felt bored	not at all	slightly	moderately	fairly	extremely
16. I felt successful	not at all	slightly	moderately	fairly	extremely
17. I felt imaginative	not at all	slightly	moderately	fairly	extremely
18. I felt that I could explore things	not at all	slightly	moderately	fairly	extremely
19. I enjoyed it	not at all	slightly	moderately	fairly	extremely
20. I felt annoyed	not at all	slightly	moderately	fairly	extremely
21. I felt pressured	not at all	slightly	moderately	fairly	extremely
22. I felt irritable	not at all	slightly	moderately	fairly	extremely
23. I lost track of time	not at all	slightly	moderately	fairly	extremely
24. I felt challenged	not at all	slightly	moderately	fairly	extremely
25. I found it impressive	not at all	slightly	moderately	fairly	extremely
26. I was deeply concentrated in the game	not at all	slightly	moderately	fairly	extremely
27. I felt frustrated	not at all	slightly	moderately	fairly	extremely
28. It felt like a rich experience	not at all	slightly	moderately	fairly	extremely
29. I lost connection with the outside world	not at all	slightly	moderately	fairly	extremely
30. I felt time pressure	not at all	slightly	moderately	fairly	extremely
31. I had to put a lot of effort into it	not at all	slightly	moderately	fairly	extremely
32. I empathized with the other(s)	not at all	slightly	moderately	fairly	extremely
33. I felt connected to the other(s)	not at all	slightly	moderately	fairly	extremely

Please flip over to complete the survey.

Please indicate how you felt while playing the game for each of the items, on the following scale.
Please circle your answer.

34. The other(s) paid close attention to me	not at all	slightly	moderately	fairly	extremely
35. I paid close attention to the other(s)	not at all	slightly	moderately	fairly	extremely
36. I found it enjoyable to be with the other(s)	not at all	slightly	moderately	fairly	extremely
37. When I was happy, the other(s) was(were) happy	not at all	slightly	moderately	fairly	extremely
38. When the other(s) was(were) happy, I was happy	not at all	slightly	moderately	fairly	extremely
39. I influenced the mood of the other(s)	not at all	slightly	moderately	fairly	extremely
40. I was influenced by the other(s) moods	not at all	slightly	moderately	fairly	extremely
41. I admired the other(s)	not at all	slightly	moderately	fairly	extremely
42. What the other(s) did affected what I did	not at all	slightly	moderately	fairly	extremely
43. What I did affected what the other(s) did	not at all	slightly	moderately	fairly	extremely
44. I felt revived	not at all	slightly	moderately	fairly	extremely
45. I felt bad	not at all	slightly	moderately	fairly	extremely
46. I found it a waste of time	not at all	slightly	moderately	fairly	extremely
47. I felt energized	not at all	slightly	moderately	fairly	extremely
48. I felt satisfied	not at all	slightly	moderately	fairly	extremely
49. I felt exhausted	not at all	slightly	moderately	fairly	extremely
50. I felt that I could have done more useful things	not at all	slightly	moderately	fairly	extremely
51. I felt powerful	not at all	slightly	moderately	fairly	extremely
52. I felt weary	not at all	slightly	moderately	fairly	extremely
53. I felt regret	not at all	slightly	moderately	fairly	extremely
54. I felt ashamed	not at all	slightly	moderately	fairly	extremely
55. I felt proud	not at all	slightly	moderately	fairly	extremely
56. I felt inspired	not at all	slightly	moderately	fairly	extremely
57. I felt creative	not at all	slightly	moderately	fairly	extremely
58. I thought of new ideas	not at all	slightly	moderately	fairly	extremely
59. I felt excitement for the future	not at all	slightly	moderately	fairly	extremely
60. Other players' ideas inspired me	not at all	slightly	moderately	fairly	extremely
61. My own ideas inspired others	not at all	slightly	moderately	fairly	extremely
62. I felt the ideas generated could make a positive difference	not at all	slightly	moderately	fairly	extremely
63. I felt this game was effective in gathering ideas	not at all	slightly	moderately	fairly	extremely
64. I would play this game again	not at all	slightly	moderately	fairly	extremely
65. I would recommend this game to other schools	not at all	slightly	moderately	fairly	extremely

Appendix J. Aha! The Game MCS Data Validation

Key Themes Data Validation

Teachers were given a Likert-scale survey with 12 statements. The five-point scale ranged from not important (1) to very important (5). The survey statements originated from the seven themes that summarized the 2,547 data points collected from our design-thinking sessions in 10 schools with 98 participants.